

In re Patent Application of:

**CONTI**

Serial No. **10/606,189**

Filing Date: **June 25, 2003**

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**REMARKS**

Applicant would like to thank the Examiner for the thorough examination of the present application. The figures and specification have been amended to change "sink" to "collector", "transmitter" to "emitter" and "intersections" to "junctions" when reference is made to transistors and/or diodes.

Independent Claims 9, 15, 23 and 33 have been amended to remove the recitation "an intersection of" to simplify the claim language. In addition, independent Claims 15, 23 and 33 have been amended to more clearly define the present invention over the cited prior art references by including the subject matter from respective dependent Claims 17, 25 and 35. These dependent claims have been cancelled.

Additionally, Applicant notes that the Examiner did not initial the last prior art reference on the information disclosure sheet filed on June 25, 2003 and has not confirmed consideration of the prior art references cited on the information disclosure sheet filed on February 16, 2006. Accordingly, it is requested that the references cited therein be confirmed as considered by the Examiner and officially made of record.

The claim amendments and arguments supporting patentability of the claims are provided below.

**I. Dependent Claim 10 is Definite**

The Examiner rejected dependent Claim 10 as being indefinite. As correctly noted by the Examiner, the control transistor as recited in independent Claim 9 is configured as a two-diode circuit when taking the parasitic PN diode into

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account. Claim 10 recites that the control transistor comprises a lateral PNP transistor. The Examiner has taken the position that since the two-diode circuit in Claim 9 is equivalent to the PNP transistor in Claim 10, then the two-diode circuit cannot use both at the same time.

The Applicant submits that the two-diode circuit in Claim 9 is not equivalent to the PNP transistor in Claim 10. The PNP transistor in Claim 10 merely defines the control transistor in Claim 9 as such. One of the diodes of the two-diode circuit is a parasitic diode as recited in Claim 9. The other diode is the control transistor configured as a diode. In Claim 10, the control transistor is defined as a lateral PNP transistor - and is still connected as a diode as defined in Claim 9. Accordingly, it is submitted that Claim 10 is definite.

## **II. The Claims Are Patentable**

The Examiner rejected independent Claim 9 over the published Tamura patent application in view of the published Clifton patent application, in view of the Ashar et al. patent and in view of the Ogawa patent. Similarly, independent Claims 15, 23 and 33 have been rejected over the published Tamura patent application in view of the published Clifton patent application.

The present invention, as recited in amended independent Claim 9, for example, is directed to a radio-frequency (RF) switching device comprising an input/output terminal, a plurality of RF channels connected to the input/output terminal, and switching means for selecting one of the plurality of RF channels based upon a switching control

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signal.

The switching means comprises a respective control module connected to each RF channel. Each control module comprises a control input for receiving the switching control signal, a PIN diode having a cathode connected to the input/output terminal, and an anode. A control transistor comprises a control terminal connected to the control input, and a first conducting terminal connected to the anode of the PIN diode. The first conducting terminal forms a common node between an anode of a PN diode formed by the control terminal and the first conducting terminal of the control transistor and a corresponding parasitic PN diode.

As noted above, the RF switching device comprises a plurality of RF channels connected to the input/output terminal. Each RF channel may advantageously be dedicated to a different transmission standard operating at different frequencies, for example. Each respective control module advantageously has very good radio-frequency isolation when one of the radio-frequency channels is selected in order to reduce the loss of energy in the selected channel. This isolation is based upon the combination of the PIN diode and the control transistor.

Amended independent Claim 15 is similar to amended independent Claim 9 but has been amended to recite that "the first conducting terminal of the control transistor forms a common node between an anode of a diode formed by the control terminal and the first conducting terminal of the control transistor, and a corresponding parasitic diode." Amended independent Claim 15 does not recite the switching means or that the diode is a PIN diode.

Amended independent Claim 23 is directed to a remote

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terminal for operating in a wireless communication system and is similar to amended independent Claim 9. Amended independent Claim 23 has also been amended similar to amended independent 15.

Amended independent Claim 33 is directed to a method for making an RF switching device and is similar to amended independent Claim 9. Amended Independent Claim 33 has also been amended similar to independent 15.

Referring now to the Tamura patent application, the Examiner cited this patent application as disclosing in FIG. 1 a radio-frequency (RF) switching device **100** comprising an input/output terminal **101**, and a plurality of RF channels **102**, **103** connected to the input/output terminal, and switching means for selecting one of the RF channels based upon a switching control signal.

In FIG. 11c in the Tamura patent application, the Examiner characterized the switching means as comprising a respective control module **307** connected to each RF channel **302**. Each control module **307** comprises a control input **CONT** for receiving the switching control signal, a PIN diode **D1** having a cathode connected to the input/output terminal, and an anode. A control transistor **Q1** comprises a control terminal connected to the control input **CONT**, and a first conducting terminal connected to the anode of the PIN diode **D1**.

As correctly noted by the Examiner, the Tamura patent application fails to disclose 1) the amount of RF channel selection in terms of a plurality, and 2) that the first conducting terminal forms a common node between an intersection of an anode of a PN diode formed by the control

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terminal and the first conducting terminal of the control transistor, and a corresponding parasitic PN diode (as best shown in FIG. 4 in the present invention).

The Examiner cited the published Clifton patent application as disclosing element 1) above, which is directed to a frequency-switching device having a plurality of frequency channels. The Examiner cited the Ashar et al. patent and the Ogawa patent as disclosing element 2) above, which in FIG. 13 (in the Ogawa patent) illustrates a transistor formed by two diodes. The two diodes are used to form the common node.

The Applicant submits that there is no motivation to combine the prior art references as suggested by the Examiner in an attempt to produce the claimed invention. For example, there is no motivation to modify the Tamura patent application to include switching means for switching one of a plurality of RF channels.

This is particularly true since the Tamura patent application is directed to a high speed switching device that can discharge an electric charge accumulated on PIN diodes **D1** and **D2** at a high speed when turning off the same PIN diodes. As noted in the background section of the Tamura patent application, high frequency communication apparatus use a high frequency switch for branching or shutting down high frequency signals.

In addition, there is no motivation to modify the respective control modules in the Tamura patent application so that a first conducting terminal of control transistor Q1 (as shown in FIG. 11C) is connected to the anode of PIN diode **D1**, while the first conducting terminal also forms a common node

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between an intersection of an anode of a PN diode formed by the control terminal and the conducting terminal of the control transistor, and a corresponding parasitic PN diode.

The Tamura patent application fails to mention parasitic diodes. The control module **306** (FIG. 11C) in the Tamura patent application works in cooperation with switches **307** and **309** so that the high frequency switch is capable of performing a high speed changeover by setting up the switches **307** and **309** as the paths for discharging the electric charge accumulated in the PIN diodes **D1** and **D2** at high speed.

Even though the Ashar et al. patent and the Ogawa patent disclose a transistor formed by two diodes, the Ashar et al. patent fails to mention connecting the transistor as a PN diode with a corresponding parasitic PN diode being associated therewith. The same may be said about the Ogawa combination of the PIN diode and the control transistor having its conducting terminal connected to the anode of the PIN diode and forming the common node between the PN diodes. The Ogawa patent discloses parasitic capacitances but fails to disclose connecting the transistor as a PN diode with a corresponding parasitic PN diode being associated therewith.

In the present invention, the RF switching device comprises a plurality of RF channels connected to the input/output terminal. Each respective control module advantageously has very good radio-frequency isolation when one of the radio-frequency channels is selected in order to reduce the loss of energy in the selected channel. As recited in amended independent Claim 9, this isolation is based upon the combination of the PIN diode and the control transistor having its first conducting terminal connected to the anode of

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the PIN diode and forming the common node between an anode of a PN diode formed by the control terminal and the first conducting terminal of the control transistor, and a corresponding parasitic PN diode.

The Applicant thus submits that even if the references were selectively combined as suggested by the Examiner, the claimed invention is still not produced. Accordingly, it is submitted that amended independent Claim 9 is patentable over the Tamura patent application in view of the Clifton patent application, the Ashar et al. patent and the Ogawa patent.

Amended independent Claims 15, 23 and 33 are similar to amended independent Claim 9. Therefore, it is submitted that these claims are also patentable over the Tamura patent application in view of the Clifton patent application.

In view of the patentability of the amended independent Claims 9, 15, 23 and 33, it is submitted that the dependent claims, which include yet further distinguishing features of the invention are also patentable. These dependent claims need no further discussion herein.

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**CONCLUSION**

In view of the amendments to the claims and the arguments provided herein, it is submitted that all the claims are patentable. Accordingly, a Notice of Allowance is requested in due course. Should any minor informalities need to be addressed, the Examiner is encouraged to contact the undersigned attorney at the telephone number listed below.

Respectfully submitted,



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